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The Ahmeyim Great Dyke of Mauritania: A newly dated Archaean intrusion

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ABSTRACT

A precise U–Pb baddeleyite age of 2733 ± 2 Ma has been obtained for the Ahmeyim Great Dyke of Mauritania that intruded into the Tasiast–Tijirit Terrane of the Reguibat Shield, NW Mauritania. This dyke is approximately 1500 m wide at the sampling area and extends for more than 150 km NNE/SSW. Major and trace element geochemistry of the dyke indicates that the magmas that formed this intrusive body were sub-alkaline, tholeiitic and boninitic, and the presence of a negative Nb anomaly indicates the involvement of subducted oceanic lithosphere during magma genesis, most likely an inherited signature from earlier subduction events and the Mesoarchaean collision of the Tasiast–Tijirit and Choum–Rag el Abiod Terranes. A palaeomagnetic study was also undertaken on samples collected from two different sections across the dyke. However, no within- or inter-site grouping of any palaeomagnetic directions could be identified, thus precluding any palaeographic interpretation. The Ahmeyim Great Dyke is interpreted to be part of the feeder system for a 2733 Ma Large Igneous Province (LIP); tholeiitic–komatiitic greenstone belts of this age are absent in the West African Craton (WAC) but are present on many other blocks. However, additional constraints are required to reliably link the Ahmeyim Great Dyke with any other such LIP-type greenstone belts in late Archaean supercontinent reconstructions. The magmas that formed the Ahmeyim Great Dyke were boninitic; this, combined with evidence of crustal contamination, the scale of the dyke and its potential link (as a feeder) to greenstone belts of tholeiitic–komatiitic affiliation within other crustal blocks suggests that it, and cogenetic magmatic units elsewhere, may be prospective for magmatic Ni–Cu–PGE sulphide exploration.

1. Introduction

The West African Craton (Fig. 1a) is a large tectonic element in the global supercontinent reconstruction "puzzle", yet it remains poorly characterised in terms both of its palaeogeography and its Large Igneous Province (LIP) record (Ernst and Bleeker, 2007; Ernst and Buchan, 2001a). However there is considerable opportunity for determining the LIP barcode of this craton, particularly of the Reguibat Shield in the northern part of the craton. Numerous regional dyke swarms that are presumably part of the plumbing system of Precambrian LIPs (cf. criteria in Ernst, 2007) are widespread throughout the Reguibat Shield (Aifa et al., 2001; Pitfield et al., 2004), with their distribution and cross-cutting relationships apparent from field observations (Pitfield et al., 2004) and a recent Google Earth-based mapping exercise (Halls, 2010). Reliable age constraints for these impressive magmatic events are sparse. A >200 km long N–S trending swarm in the eastern part of the shield has been studied and a Pb–Pb age of 1.95 Ga was reported (Aifa et al., 2001; Halls, 2010). An ENE-trending magnetic anomaly that extends for at least 500 km may also be related to large Jurassic-age dykes in Morocco and the Iberian Peninsula (Halls, 2010; Touil, 2008). These, therefore, may belong to the 200 Ma Central Atlantic Magmatic Province (CAMP), a LIP present on all continental margins of the Atlantic Ocean that is linked with the rifting, development and eventual opening of the Atlantic (e.g., Marzoli et al., 1999; Schoene, et al., 2011).

The major intraplate magmatic history of a crustal block can be summarized as a LIP 'barcode' (e.g., Bleeker, 2003; Bleeker and Ernst, 2006; Ernst and Bleeker, 2010). This concept is useful for constraining palaeocontinental reconstructions in that the LIP barcode record of different crustal blocks can be compared to identify those which have sufficient matches over a time interval of a few hundred My to indicate they may have been nearest neighbours over that time interval. Previous LIP barcode lines for the West African Craton (WAC) are: at 200 (CAMP), 560 Ma (Ouarzazate), ca. 800 Ma (Bir El Khzaim) and at

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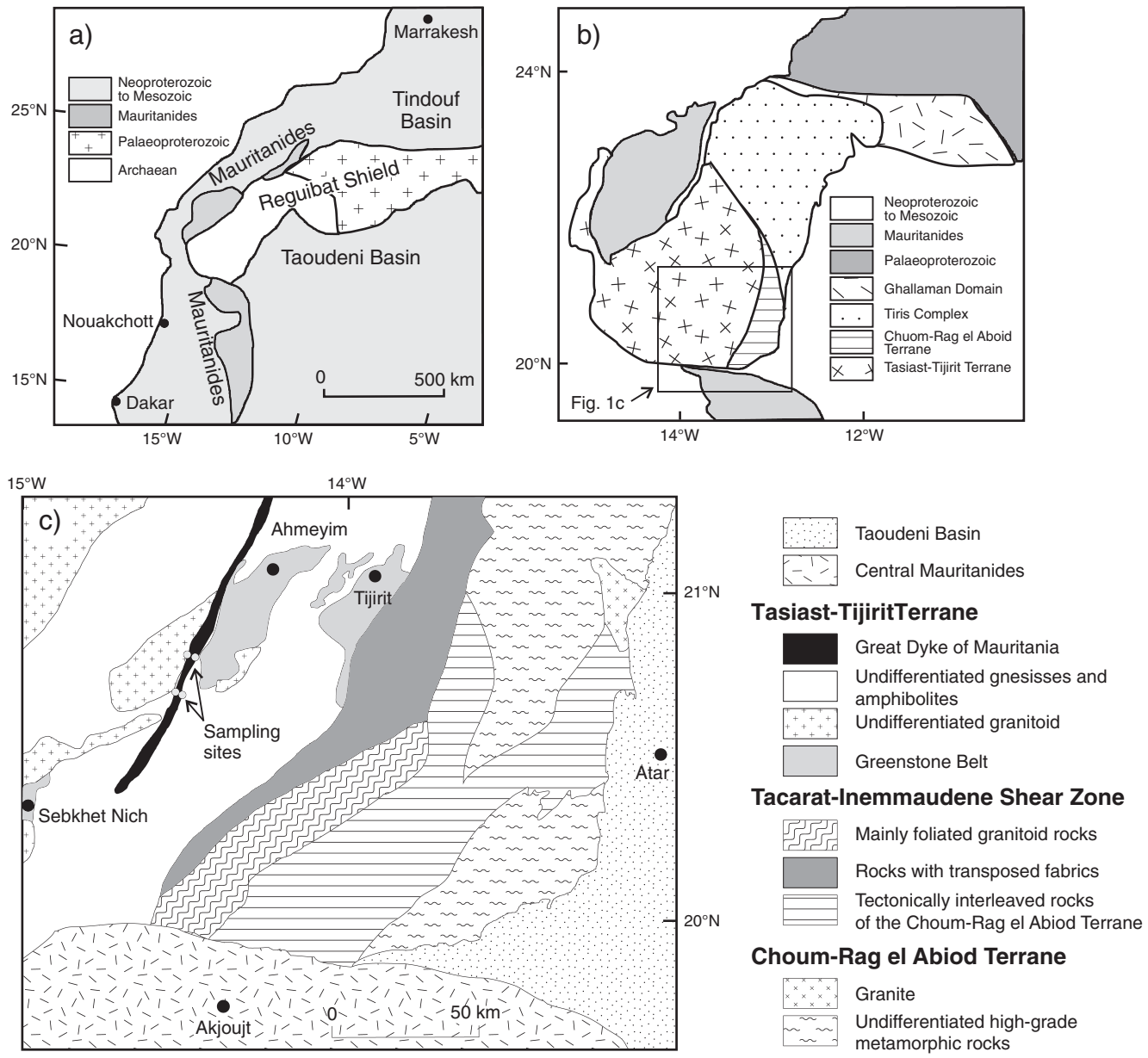

Fig. 1. a) Geological sketch map of the W African Craton (from Deynoux et al., 2006); b) geological sketch map of the Tasiast-Tijitit Terrane and c) the Ahmeyim Great Dyke of Mauritania showing sampling sites (after Key et al., 2008 and Schofield et al., 2012).

2040 Ma (Ierhourtane). Other papers in this special issue are starting to fill in the Proterozoic part of the LIP record and to provide preliminary reconstructions involving the WAC in the Nuna and Rodinia supercontinents based on successful barcode matches with other blocks (El Bahat et al., 2013; Kouyaté et al., 2013-this volume; Youbi et al., 2011; cf. Ernst and Buchan, 2001a). Here, we investigate the age and setting of the Ahmeyim Great Dyke of Mauritania as a potential new LIP barcode line for this portion of West African Craton.

1.1. Geological setting

Archaean to Palaeoproterozoic basement rocks of the West Africa Craton were amalgamated by mid-Palaeoproterozoic times, leading to the formation of a relatively stable craton at ~1.7 Ga (Caby and Kienast, 2009; Deynoux et al., 2006; Key et al., 2008; Schofield et al., 2006, 2012). Much of the craton is now covered by Mesoproterozoic sedimentary rocks of the Taoudéni Basin, with the most important basement outcrops being the Reguibat Shield, representing the northwestern part of the craton to the west of the Taoudéni Basin (Fig. 1), and the Léo Shield that is exposed to the south. No major pre-Pan-African tectono-metamorphic events have been recognised in either shield since late Palaeoproterozoic and Mesoproterozoic times, and the absence of "Grenvillian" age (around 1.0 Ga) orogenic events in West Africa excludes an active role in the formation of the supercontinent Rodinia.

The Reguibat Shield is subdivided into two distinct structural units: an Archaean province in the south-west and a Palaeoproterozoic province to the north-east (Fig. 1b) which comprises early Palaeoproterozoic rocks affected by the ~2.0 Ga Eburnean Orogeny (Bessoles, 1977; Dillon and Sougy, 1974; Rocci et al., 1991; Schofield and Gillespie, 2007). The Archaean province of the southernmost part of the Reguibat Shield comprises two distinct terranes that have different Mesoarchaean geological histories; the Tasiast–Tijirit Terrane to the west, and the Choum–Rag el Abiod Terrane to the east (Key et al., 2008; Pitfield et al., 2004). The Tasiast–Tijirit Terrane (Fig. 1c) consists of a typical Archaean association of granites, greenstone belts and granitoid gneisses. The oldest rocks are